Original Article

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Carotid Intima-media Thickness and Epicardial Fat Thickness in Patients with and without Metabolic Syndrome: A Correlative Study

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Abstract

Introduction: The presence of metabolic syndrome (MetS) in an individual confers increased the risk of cardiovascular disease. It is an important risk factor for mortality, morbidity, and decreased life span. There are a very few studies from India regarding the correlation of carotid intima-media thickness (CIMT) and epicardial thickness in MetS patients.

Objectives: To investigate the relationship, if any, between CIMT and epicardial fat thickness (EFT) in patients with and without MetS.

Materials and Methods: This was a prospective cross-sectional hospital based study. A total of 60 patients were studied. 30 with MetS and 30 without MetS anthropometric measurements were recorded, and patients underwent transthoracic echocardiography and ultrasound of carotids. EFT and CIMT were measured, and results were analyzed statistically.

Results: 60 patients were studied. 30 were MetS and 30 were non-MetS. 32 were male and 28 were female. The mean CIMT (mm) among MetS patients was (male-1.80, female-2.02) and non-MetS was (male-1.45, female-1.42). The mean EFT among MetS patients (mm) was (male-8.17, female-9.67) and non-MetS (male-4.52, female-4.38), respectively. The differences were statistically significant. In the MetS group, CIMT and EFT showed a significant correlation which was not so in non-MetS group. In the MetS, CIMT showed a positive correlation with body mass index (BMI) and waist circumference (WC) and no positive correlation with waist-hip ratio (WHR) and cholesterol levels. Among the non-MetS patients, CIMT showed no positive relation with BMI, WC, WHR, and cholesterol levels. Among the MetS patients, EFT showed a positive relation with BMI and WC and no positive relation with WHR and cholesterol levels. Among the non-MetS patients, EFT showed no positive relation with BMI, WC, WHR, and cholesterol levels.

Conclusion: EFT and CIMT were significantly correlated among MetS while not significantly correlated among non-MetS patients, suggesting that EFT can be used as an alternative for CIMT in predicting cardiometabolic risk.

Key words: Carotid atherosclerosis, Cardiac imaging, Syndrome X, Visceral fat

INTRODUCTION

The metabolic syndrome (MetS) refers to the presence of three or more abnormalities (impaired glucose metabolism, elevated blood pressure, hypertriglyceridemia, low-density lipid cholesterol [LDL] and high-density lipid cholesterol [HDL], and central obesity) in the same person.[1] Several studies showed high prevalence of the MetS in different high-risk populations,[2,3] but the magnitude of the MetS became apparent when in an apparently healthy population a prevalence of nearly 24% was found.[4]

MetS is an important risk factor for high risk of mortality, prolonged morbidity, and decreased life span. MetS is a powerful predictor of cardiovascular (CV) events such as the risk of myocardial infarction (MI), stroke, and peripheral arterial disease.

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Epicardial adipose tissue (EAT) is defined as adipose tissue situated within the pericardium. EAT is of interest because of its close anatomic relationship with the myocardium. EAT is believed to have an independent correlation with coronary artery disease (CAD),[5] and EFT is also correlated with abdominal visceral fat volume and EFT measured by echocardiography correlates with magnetic resonance imaging (MRI) measurement.[6] It is also associated with obesity-related insulin resistance and fasting glucose.[7] It is strongly correlated with waist circumference (WC) and carotid intima-media thickness (CIMT),[8] and it reduces on weight reduction.[9] It is directly related to total cholesterol, LDL, triglycerides, ApoA, ApoB, visceral fat hormones and inversely related to HDL.[10] It is directly related to severity of CAD and number of vessels involved in CAD, where EFT is proportionately higher in multivessel CAD than 1- or 2- vessel CAD.[10] It is more informative than abdominal obesity as predictor of coronary atherosclerosis.[10]

Over the past years, a large number of trials have been performed in which CIMT was used as an alternative end point for CV morbidity and mortality to study the efficacy of certain interventions. The main advantage of using CIMT as an end point in a trial over morbidity and mortality as end points is the considerable reduction in sample size and possibly shorter duration of follow-up.[11] Studies of the association between CIMT and coronary atherosclerosis, as assessed by coronary angiography, show generally modest positive associations.[12,13]

The literature from India in this regard is sparse. Hence, this study was taken up.

MATERIALS AND METHODS

This was a prospective, comparative, non-interventional, case-control study carried out between October 2013 and October 2015 in the Department of Medicine, JSS Hospital, a tertiary care teaching hospital in Mysore city. A total of 60 patients of both sexes aged between 18 and 65 years were studied. Patients satisfying three or more MetS alterations such as central obesity, hypertriglyceridemia, LDL-HDL cholesterol, and hypertension impaired fasting glucose or previously diagnosed. Type 2 diabetes was included. Excluded were those with hypothyroidism, chronic kidney disease, chronic liver disease, past neck surgery, and pregnancy.

Echocardiography was performed using Philips HD 11 XE Machine by a single observer for all the subjects. EFT was measured from parasternal long and short axis B-mode still free images perpendicularly to the free wall of right ventricle at end-systole in three cardiac cycles, using the aortic annulus as the anatomic reference for the parasternal log axis view and the papillary muscle level for short axis view. Epicardial fat thickness (EFT) was measured at end-systole.[6]

Ultrasound carotid was performed using Philips HD 11 XE Machine by a single observer. The CIMT was measured on the far wall at 1 cm from the bifurcation of the common carotid artery as the distance between the lumen-intima interface and the media-adventitia interface. Blood sugar levels were estimated using the glucose oxidation method. HbA1c was done using HPLC method. Insulin levels were measured using chemiluminescence immunoassay method. Lipid profile was done using Agappe lipid profile kit.

Statistical Analysis

Descriptive statistics was used to identify frequencies and the mean scores of the sample. Independent sample *t*-test was computed to compare variables with each other. The relationship between the variables was explored using bivariate correlational analysis using SPSS version 16.0.

RESULTS

Among the 60 subjects, 32 (53.3%) were males and 28 (43.6%) were female. The age ranged from 18 to 60 years. 1 (1.6%) from the age group of 18-20, 4 (6.6%) from the group of 21-30, 10 (16.6%) from 31 to 40 group, 20 (33.3%) from 41 to 50 group, and those from 51 to 60 were 25 (41.6%). 32 (53.3%) were males and 28 (43.65%) female. 30 (50%) were MetS patients and 30 (50%) were non-MetS patients.

Comparison of EFT among MetS and non-MetS Group (Table 1) revealed that the mean scores of MetS group was higher (M = 8.77, standard deviation [SD] = 1.89) than the control group (M = 4.45, SD = 0.99). These differences in the mean scores of the two groups were found to be statistically significant.

On comparing the CIMT among MetS and non-MetS group (Table 2), it was observed that the mean scores of MetS group was higher (mean [M] = 1.89, SD = 0.30) than the control group (M = 0.30, SD = 0.09). However, this difference was not found to be significant. This indicates that there is no difference in the CIMT level of MetS and controlled group participants.

The bivariate correlational analysis was done to find the relationship between EFT and CIMT of MetS patients (Table 3). The results showed that there was a positive and significant correlation between EFT and CIMT of MetS patients with a $P = 0.00$ and $r = 0.789$.

Table 1: Comparison of EFT between MetS and non-MetS group

Group	*N*	Mean	SD	*t*	Significant
MetS	30	8.77	1.89	11.06	0.00
Non-MetS group	30	4.45	0.99		

EFT: Epicardial fat thickness, MetS: Metabolic syndrome, SD: Standard deviation

Table 2: Comparison of CIMT between MetS and non-MetS group

Group	*N*	Mean	SD	*t*	Significant
MetS	30	1.89	0.30	7.902	0.00
Non-MetS	30	1.44	0.09		

CIMT: Carotid intima-media thickness, MetS: Metabolic syndrome, SD: Standard deviation

Table 3: Bivariate correlation between EFT and CIMT of MetS patients

Pearson correlation	CIMT
EFT	0.789**
Significant two-tailed	0.00
n	30

CIMT: Carotid intima-media thickness, MetS: Metabolic syndrome, EFT: Epicardial fat thickness, ***p* value of .00 and *r* value of .789

DISCUSSION

The association of obesity with CV disease depends both on the amount of body adiposity and its distribution. Those with increased fat in the abdominal region have atherogenic lipid profiles and are at increased CV risk. The loss of elasticity in medium and large arteries is an early manifestation of atherosclerosis. This study aimed to evaluate whether EAT, as determined by echocardiography, is related to CIMT, an index of subclinical atherosclerosis.

Aydin *et al*. conducted a study on 2102 participants. CIMT was measured in all of the participants. The study sample was divided into 4 groups; Group 1 subjects with a body mass index (BMI) < 25.0 kg/m^2, Group 2 BMI between 25.0 and 29.9 kg/m^2, Group 3 BMI between ≥ 30 kg/m^2 and 39.9 kg/m^2, and Group 4 BMI ≥ 40 kg/m^2. CIMT was higher in the individuals with MetS compared to their normal counterparts. Furthermore, the subgroup analysis showed that CIMT values in Group 1, Group 2, and Group 3 were significantly higher in subjects with MetS compared to their normal counterparts, whereas the values were similar in Group 4. They concluded that CIMT of overweight, obese, and normal weight individuals without MetS were lower than their counterparts with MetS. In our study, the CIMT in MetS patients was higher when compared with the normal individuals, but the difference was not statistically significant.

Reinehr *et al*. had analyzed the relationships between MetS and IMT in 461 overweight adolescents aged 10-18 years. Overweight adolescents with MetS demonstrated increased IMT values compared with overweight adolescents without MetS. The use of dichotomized variables reduced the diagnostic accuracy. Thus, in clinical practice, treatment of overweight adolescents should be based on weighing CV risk factors themselves, rather than on the dichotomous variable MetS.

In our study, the IMT of the common carotid-internal carotid artery measured by carotid artery Doppler with a minimum of 0.6 mm and maximum of 1.6 mm.

Jeong *et al*.[14] in their study of 203 IHD patients which included MI, stable angina, and unstable angina and tried to correlate it with the Carotid Intima Media Thickness. The mean age was 63.1 ± 10.4 years. In 108 male patients, the mean value of EFT was 6.38 mm (1.10-16.55 mm). They had found that the incidence of CAD increases with increase in EFT. There was no significant difference in the EFT as per the patient's clinical diagnosis was concerned. They had found a significant correlation of EFT with age, C-reactive protein, BMI, and WC. In our study, the EFT found to be increased in patients with MetS (male-8.17, female-9.67) when compared with non-MetS patients (male-4.52, female-4.38) and the EFT was significantly and positively related with BMI and WC and no correlation with WH ratio and cholesterol levels and our findings correlated with Jeong *et al*.[14]

Iacobellis and Leonetti studied 30 obese subjects and compared EFT with Insulin resistance. They found that the thickness of EFT in the free wall of right ventricle ranged from 4 to 17.4 mm. The EFT was significantly correlated with WC, BMI, and fasting glucose levels. The present study also showed that EFT is significantly correlated with WC in obese subjects. They concluded that EFT was significantly correlated with obesity-related insulin resistance.

One of the strengths of this study is that all the echocardiographic measurements were done by a single physician trained in echocardiography. However, this study is not without limitations. The number of subjects studied could have been large. Furthermore, MRI was not used which gives a better estimate of EFT.

In the evaluation of cardiological disorders, echocardiography is used for the assessment of left ventricle function and other parameters. The cardiac patient being evaluated by the cardiologist/physician undergoes routine echocardiography and in the same setting ejection fraction can be measured by the same specialist, thus avoiding the need for another

scan (ultrasonography abdomen) by another specialist (radiologist).

CONCLUSION

The CIMT and EFT were significantly correlated in patients with MetS when compared with non-MetS patients, suggesting that MetS patients are prone for cardio MetS risks when compared with non-MetS patients. EFT can be used as an alternative for CIMT in predicting CV risks.

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